CLAIMS

[0060] 1. A seal assembly positioned in a transverse bore of a seal carrier in a valve, the seal carrier shifting from a closed position to an open position, and the valve having a pair of opposing seal plates, the seal assembly being aligned with the seal plates when the seal carrier is in the closed position, and the seal assembly being out of alignment with the seal plates when the seal carrier is in the open position, the seal assembly being exposed alternatively to supply pressure and to function pressure, the seal assembly comprising:

a seal spool having a central circular collar and a transverse axle, a first end portion of the axle extending from one side of the collar and a second end portion of the axle extending from the opposite side of the collar;

a first seal cup having a through bore, a portion of the bore being sized and arranged to receive the first end portion of the axle, the seal cup having a sealing surface to seal against the opposing seal plate;

a second seal cup having a through bore, a portion of the bore being sized and arranged to receive the second end portion of the axle, the second seal cup having a sealing surface to seal against the opposing seal plate;

a first O-ring positioned around the first end portion of the axle;

a first pair of generally triangular back-up rings having a first triangular back-up ring positioned around and in contact with the first end portion of the axle between the first seal cup and the first O-ring and a second triangular back-up ring positioned around and separated from the first end of the axle between the first seal cup and the first O-ring;

a second O-ring positioned around the second end portion of the axle; and

a second pair of generally triangular back-up rings having a first triangular back-up ring positioned around and in contact with the second end portion of the axle between the second seal cup and the second O-ring and a second triangular back-up ring positioned around and separated from the second end portion of the axle between the second seal cup and the second O-ring; and

the first O-ring compressed by the first seal cup and first pair of triangular back-up rings against the collar and the second O-ring compressed by the second seal cup and second pair of triangular back-up rings against the collar so the O-rings act as seals and as springs urging the seal cups into contact with the opposing seal plates and the first and the second pairs of triangular back-up rings prevent extrusion of the O-rings through the through bore of the seal cups and the transverse bore of the seal carrier.

[0061] 2. The apparatus of claim 1 wherein the O-rings are compressed axially more than 38.5 percent between the collar and the seal cups.

[0062] 3. The apparatus of claim 1 wherein the seal assembly is exposed to supply pressure and such pressure enters the through bores in each seal cup energizing both O-rings and forcing them out of contact with the axle and into sealing contact with the transverse bore of the seal carrier, the second triangular back-up rings of the first and second pairs of triangular back-up rings and the seal cups so supply pressure can force both seal cups into sealing engagement with the seal plates.

[0063] 4. The apparatus of claim 3 wherein the seal assembly is exposed to function pressure and such pressure enters the transverse bore of the seal carrier energizing both O-rings and

forcing them out of contact with the transverse bore and into sealing contact with the seal spool, the first triangular back-up rings of the first and second pairs of triangular back-up rings and the seal cups so function pressure can force both seal cups into sealing contact with the seal plates.

[0064] 5. A seal assembly positioned in a transverse bore of a seal carrier in a valve, the seal carrier shifting from a closed position to an open position, and the valve having a pair of opposing seal plates, the seal assembly being aligned with the seal plates when the seal carrier is in the closed position, and the seal assembly being out of alignment with the seal plates when the seal carrier is in the open position, the seal assembly being exposed alternatively to supply pressure and to function pressure, the seal assembly comprising:

a seal spool having a central circular collar and a transverse axle, a first end portion of the axle extending from one side of the collar and a second end portion of the axle extending from the opposite side of the collar;

a first seal cup having a through bore, a portion of the bore being sized and arranged to receive the first end portion of the axle, the seal cup having a sealing surface to seal against the opposing seal plate;

a second seal cup having a through bore, a portion of he bore being sized and arranged to receive the second end portion of the axle, the second seal cup having a sealing surface to seal against the opposing seal plate;

a first O-ring positioned around the first end portion of the axle;

a first pair of triangular back-up rings having a first triangular back-up ring positioned around and in contact with the first end portion of the axle between the first seal cup and the first

O-ring and a second triangular back-up ring positioned around and separated from the first end portion of the axle between the first seal cup and the first O-ring;

a second O-ring positioned around the second end portion of the axle; and

a second pair of triangular back-up rings having a first triangular back-up ring positioned around and in contact with the second end portion of the axle between the second seal cup and the second O-ring and a second triangular back-up ring positioned around and separated from the second end portion of the axle between the second seal cup and the second O-ring

[0065] 6. The apparatus of claim 5 wherein the O-rings are squeezed axially more than 38.5 percent between the collar and the seal cups.

[0066] 7. The apparatus of claim 5 wherein the seal assembly is exposed to supply pressure and such pressure enters the through bores in each seal cup energizing both O-rings and forcing them out of contact with the axle and into sealing contact with the transverse bore of the seal carrier, the second triangular back-up rings of the first and second pairs of triangular back-up rings and the seal cups so supply pressure can force both seal cups into sealing engagement with the seal plates.

[0067] 8. The apparatus of claim 7 wherein the seal assembly is exposed to function pressure and such pressure enters the transverse bore of the seal carrier energizing both O-rings and forcing them out of contact with the transverse bore and into sealing contact with the seal spool,

the first triangular back-up rings of the first and second pairs of triangular back-up rings and the seal cups so function pressure can force both seal cups into sealing contact with the seal plates.

[0068] 9. A dirty fluid valve with bi-directional seal assembly positioned in a downhole tool for sampling of wellbore fluids and storage of such wellbore fluids in a sample collection bottle, the dirty fluid valve being connected to a pilot open valve and a pilot close valve to open and close the dirty fluid valve, both pilot valves connected to a source of pressurized pilot fluid, the dirty fluid valve comprising:

a body having a longitudinal bore sized and arranged to receive a seal carrier, the seal carrier being in contact with a spring urging the seal carrier into a closed position;

the body defining at least one open port in fluid communication with an open chamber, both the open port and the open chamber being in fluid communication with the pilot open valve to shift the seal carrier to an open position in response to pressurized pilot fluid entering the open chamber to allow wellbore fluids to pass through the dirty fluid valve and into the sample collection bottle;

the body defining at least one close port in fluid communication with a close chamber, both the close port and the close chamber in fluid communication with the pilot close valve to shift the seal carrier back to the closed position in response to pressurized pilot fluid entering the close chamber;

a pair of opposing seal plates positioned in the body, each seal plate having a through hole in fluid communication with a supply port in the body, the supply ports being in communication with the wellbore fluids;

a pair of opposing function ports in the body, the function ports in fluid communication with the longitudinal bore and the sample collection bottle;

the seal carrier having a transverse bore sized and arranged to receive a bi-directional seal assembly comprising:

a seal spool having a central circular collar and a transverse axle, a first end portion of the axle extending from one side of the collar and a second end portion of the axle extending from the opposite side of the collar;

a first seal cup having a through bore, a portion of the bore being sized and arranged to receive the first end portion of the axle, the seal cup having a sealing surface to seal against the opposing seal plate;

a second seal cup having a through bore, a portion of he bore being sized and arranged to receive the second end portion of the axle, the second seal cup having a sealing surface to seal against the opposing seal plate;

a first O-ring positioned around the first end portion of the axle;

a first pair of triangular back-up rings having a first triangular back-up ring positioned around and in contact with the first end portion of the axle between the first seal cup and the first O-ring and a second triangular back-up ring positioned around and separated from the first end portion of the axle between the first seal cup and the first O-ring;

a second O-ring positioned around the second end portion of the axle; and

a second pair of triangular back-up rings having a first triangular back-up ring positioned around and in contact with the second end portion of the axle between the

second seal cup and the second O-ring and a second triangular back-up ring positioned around and separated from the second end portion of the axle between the second seal cup and the second O-ring.

[0069] 10. The apparatus of claim 9 wherein the O-rings are squeezed axially more than 38.5 percent between the collar and the seal cups.

[0070] 11. The apparatus of claim 9 wherein the seal assembly is exposed to supply pressure and such pressure enters the through bores in each seal cup energizing both O-rings and forcing them out of contact with the axle and into sealing contact with the transverse bore of the seal carrier, the second triangular back-up rings of the first and second pairs of triangular back-up rings and the seal cups so supply pressure can force both seal cups into sealing engagement with the seal plates.

[0071] 12. The apparatus of claim 11 wherein the seal assembly is exposed to function pressure and such pressure enters the transverse bore of the seal carrier energizing both O-rings and forcing them out of contact with the transverse bore and into sealing contact with the seal spool, the first triangular back-up rings of the first and second pairs of triangular back-up rings and the seal cups so function pressure can force both seal cups into sealing contact with the seal plates.